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Endogenous resources utilization of rural areas in shaping sustainable development in Poland

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ABSTRACT

The article presents rural areas in Poland in the context of endogenous resources utilization and functional diversification in 2007 and 2008. One of the directions of multifunctional rural development is renewable energy production based on local resources.

Effective utilization of both environmental and technological resources for agricultural production was discussed by the reference to the energy crops production. Energy crops pose an alternative source of energy (biomass) and are based on local energy resources. Moreover, the energy crops production is also an example of diffusion of both technological and technical innovation.

An important rural endogenous resource is a human factor. On the basis of the obtained results it has been concluded that young people are more creative; they are leaders in innovation implementation.

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1. Introduction

This paper aims at presenting the analysis and assessment of biomass production based on energy crops in Poland in 2007 and 2009. The study refers to selected endogenous resources, i.e. human resources (age structure), natural resources (quality of agricultural production space) as well as organizational resources (average farm size). The research included only those gminas[1] in which energy crops were grown in 2007 and 2009. Crop production diversification, for instance by introducing energy crops, is an example of diffusion of both technological and technical innovation.

More and more attention is paid to the rules of sustainable development in the socio-economic development of individual states and regions of the world. This trend is reflected in various governmental documents as well as in strategic planning. In Poland such documents include the Constitution of the Republic of Poland and the Law on Environmental Protection (2001). Socio-economic sustainable development is defined as a kind of compromise between the necessity to keep the natural environment and the needs of both the economy and the society [1].

The best way to reach sustainable (harmonious) socio-economic development on the regional level-according to Grosse [2] is to diversify regional specialization by using innovations and modern technologies based on endogenous resources. Due to specificity of rural areas, the effectiveness of the innovations being introduced is conditioned by proper level of knowledge, both explicit and tacit, as well as its transfer [3,4]. A large role in the process of innovation diffusion in rural areas belongs to local leaders–initiators of new technologies. Thanks to their cooperation a network for information flow is created. Moreover the economic activities undertaken by them stimulate other people living in rural area [5].

In the above context it is assumed that the development of renewable energy in rural areas, is based on diffusion of innovations. It is assumed, thus, that the initiators of the renewable energy development are at the working age. Human capital (age, education) contains impulses for innovations. The young, better educated

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[1] gmina: administrative region of the 3rd order.

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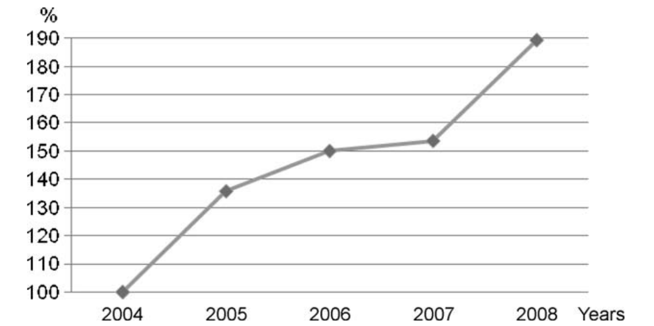


Fig. 1. Electricity production based on biomass and biogas in Poland between 2004 and 2008 (2004 = 100%).

Source: developed by the authors based on [12].

and mobile are often open-minded and creative and become leaders who introduce innovations.

Moreover, it is assumed that using local energy resources remains an important factor of the alternative energy development in rural areas. Consequently, it is supposed that the natural conditions, such as low fertility agricultural land, condition the dissemination of energy crops as a biomass source.

2. Biomass for energy production in Poland

Many specialists pay attention to the importance of biomass production. It is particularly important in the context of sustainable development [6] The reasons biomass is presently seen as the most promising source of renewable energy in Poland include low investment costs connected with its processing and direct burning [7]. Diversification of crop production towards high-energy crops is an example of introducing innovative practices which consider the aspect of environmental protection. Besides, it poses an alternative source of income for the society and as such it supports economic activation of rural area [8,9].

The world's leader in the biomass production is Asia (43%), while European's is Germany. In 2006 biogas power production in Germany increased by 56% [10]. Considering the structure of the renewable energy production in Poland in the years 2004–2008 it must be stressed that the share of the energy produced in both biogas and biomass power stations almost doubled (Fig. 1). Moreover, the energy production from co-burning of biomass also increased. In 2007 it amounted to 39.2%, while in 2008 to 46%, i.e. nearly half of the energy produced from renewable resources [11].

Increase crop production for energy purposes in Poland is based on economic reasons, i.e. the desire to increase incomes by getting subsidies gained for energy crops. The subsidies first come from the state's budget and next also from the EU funds. Besides, as Wielewska [13] indicates, the other economic impulse which increases the dynamics of the energy crops introduction is their high price.

It must be stressed that in the years 2005–2006 the national budget financed two species of energy plants: willow (*Salix L.*) and multiflora rose (*Rosa multiflora*). In terms of spatial distribution in 2006 the largest share of these two species among perennial crops was recorded in the following voivodeships[2]: Wielkopolskie, Lubuskie and Warmińsko-Mazurskie (north and west Poland), while the lowest in the Lubelskie Voivodeship (east Poland) (Fig. 2).

The situation of energy crops changed significantly in the 2007 year as besides the financial support from the national budget some support came from the European Union funds. Moreover, more

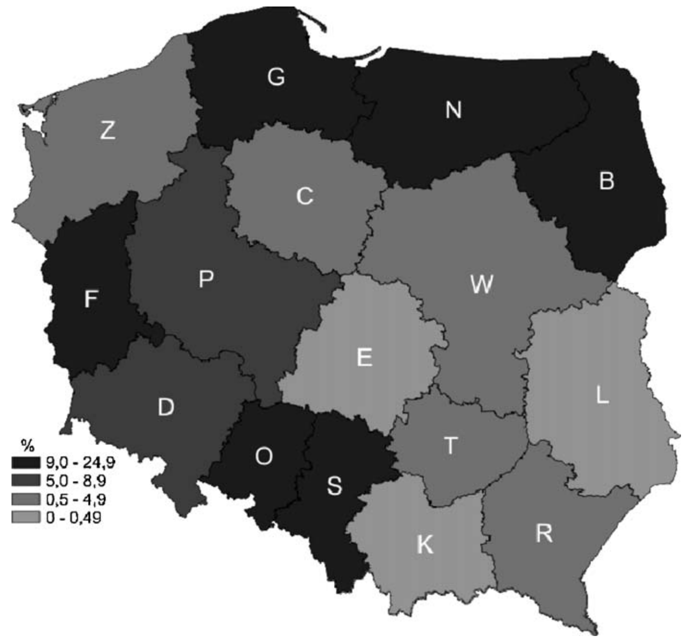


Fig. 2. Share of energy crops in the perennial crops area in Poland's voivodeships in 2006 (%). Explanation: Voivodeships: B-Podlaskie; C-Kuiawsko-Pomorskie; D-Dolnośląskie; E-Łódzkie; F-Lubuskie; G-Pomorskie; K-Małopolskie; L-Lubelskie; N-Warmińsko-Mazurskie; O-Opolskie; P-Wielkopolskie; R-Podkarpackie; S-Śląskie; T-Świętokrzyskie; W-Mazowieckie; Z-Zachodniopomorskie.

Source: developed by the authors based on the data collected from The Agency for Restructuring and Modernisation of Agriculture (ARMA) and The Regional Data Bank of the Central Statistical Office of Poland (RDB CSO).

energy crops were included in the list of subsided species. The process of diffusion innovation in the form of introducing new crops is uneven and it mainly refers to the west and south-east Poland. In relation to the year 2007, in 2009 a general decrease energy crops area was recorded (from 1058.5 km^2 to 446.7 km^2).

A particular attention should be paid to the Opolskie Voivodeship where a considerable growth in the energy crops area was recorded. In the Opolskie Voivodeship in 2007 the percentage of rural and rural–urban gminas with such crops was 86.8% and in 2009 it was 85.3%. The Opolskie Voivodeship important role in energy crops production confirms the increase share of gminas among the gminas where the energy crops area was 200 hectares and more. In 2007 this participation was 18.1%, in 2008 to 27.5%, and in 2009 one third of this gminas in Poland was located within the administrative boundaries of Opolskie Voivodeship (Fig. 3).

Considering the share of energy crops in gminas in relation to the total energy crops area in Poland, it must be underlined that they are occurred in some aggregations. In 2007 as much as 73% of energy crops concentrated in three voivodeships: Zachodniopomorskie, Wielkopolskie and Opolskie. In 2009, however, in the five following voivodeships: Opolskie, Zachodniopomorskie, Dolnośląskie, Wielkopolskie and Pomorskie. The Zachodniopomorskie Voivodeship is a specific case as in 2007 energy crops took as much as 34.4% of the total energy crop area in Poland while in 2009 it was only 15.9%. In 2009 the largest concentration of energy crops of 28.8% was noted in the Opolskie Voivodeship (Fig. 4).

In accordance with the data from the Agricultural Market Agency (state on 01.04.2010) referring to the distribution of the companies which either purchase energy crops or process them initially for energy production the same voivodeships were the leaders (Wielkopolskie and Zachodniopomorskie) as well as the Kujawsko-Pomorskie. There are 525 such firms; in the Wielkopolskie Voivodeship there are 78 (almost 15% of the total number)

[2] voievodeship: administrative region of the 1st order.

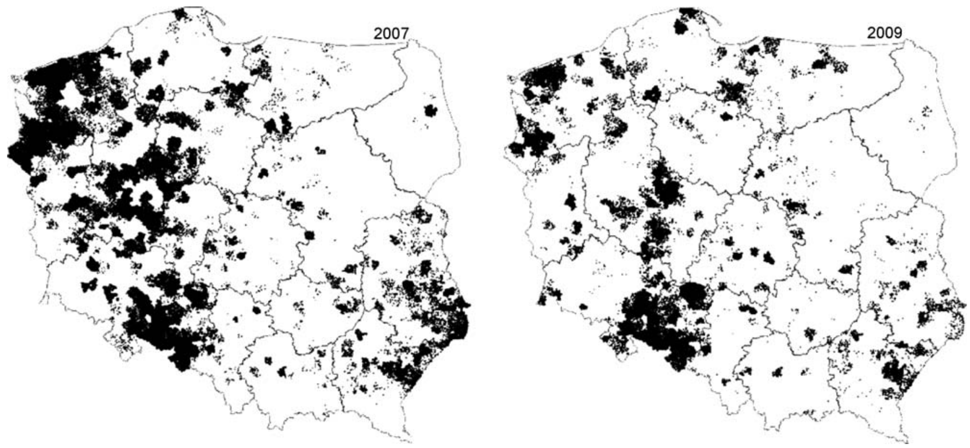


Fig. 3. Energy crops area in Poland in 2007 and 2009. Explanation: A-1 point = 1 hectare of energy crops area.
Source: developed by the authors based on the data collected from ARMA and RDB CSO.

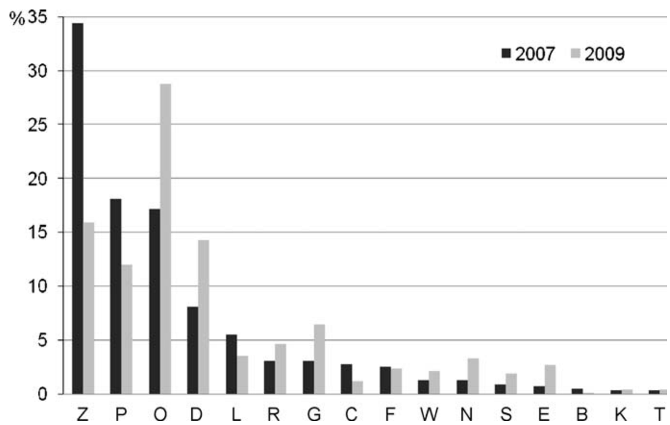


Fig. 4. Share of energy crops area in voivodeships in total energy crops area in Poland in 2007 and 2009 (%). Explanation: Voivodeships: B-Podlaskie; C-Kuiawsko-Pomorskie; D-Dolnośląskie; E-Łódzkie; F-Lubuskie; G-Pomorskie; K-Małopolskie; L-Lubelskie; N-Warmińsko-Mazurskie; O-Opolskie; P-Wielkopolskie; R-Podkarpackie; S-Śląskie; T-Świętokrzyskie; W-Mazowieckie; Z-Zachodniopomorskie.

Source: developed by the authors based on the data collected from ARMA.

while the Zachodniopomorskie and Kujawsko-Pomorskie have 62 each (i.e. 11.8% each).

3. Renewable energy in Poland against the selected endogenous factors in 2007 and 2009

The most important endogenous condition of agricultural production remains the agricultural land and its quality. In this paper adduced to scoring scale, which in Poland is applicable to assess the agricultural land quality. The scale is based on data relate to natural environment and technical resources.

The discussed gminas are diversified in terms of the quality of their agricultural production space. The majority of gminas characterized medium agricultural land quality (75 point or less); these were the areas located in Zachodniopomorskie region, in the northeast of the Opolskie region, central Wielkopolska region and north Lubelskie region (Fig. 5). In relation to 2007, the year 2009 showed an inconsiderable increase those gminas in which recorded the highest agricultural land quality.

The next issue considered in this article is the interrelation between the distribution and energy crops area on one side, and the farms size. In general, there is a certain interdependency between the above factors, as these are larger farms which give larger areas for energy crops. The value of the correlation coefficient between the share of energy crops in the total cultivated area of 20% or

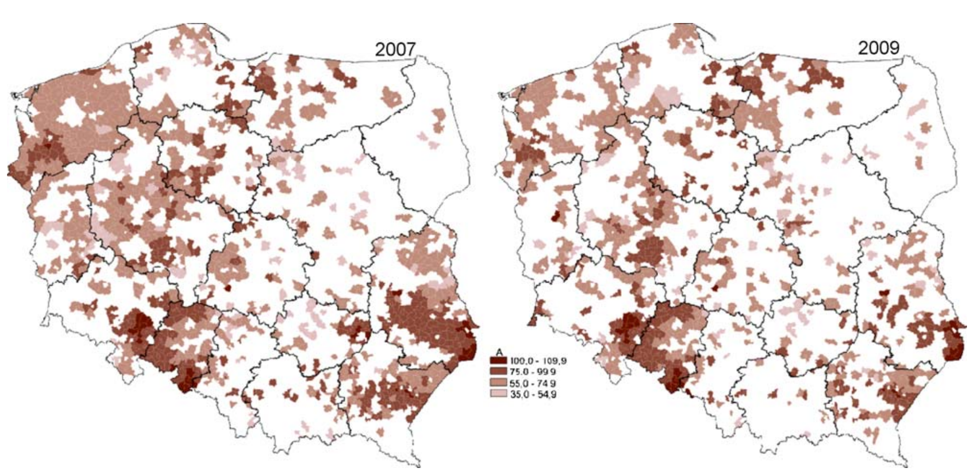


Fig. 5. Agricultural land quality in the gminas where energy crops are grown in Poland in 2007 and 2009. Explanation: A-agricultural land quality (in points).
Source: developed by the authors based on the data collected from ARMA and Institute of Soil and Plant Cultivation in Puławy.

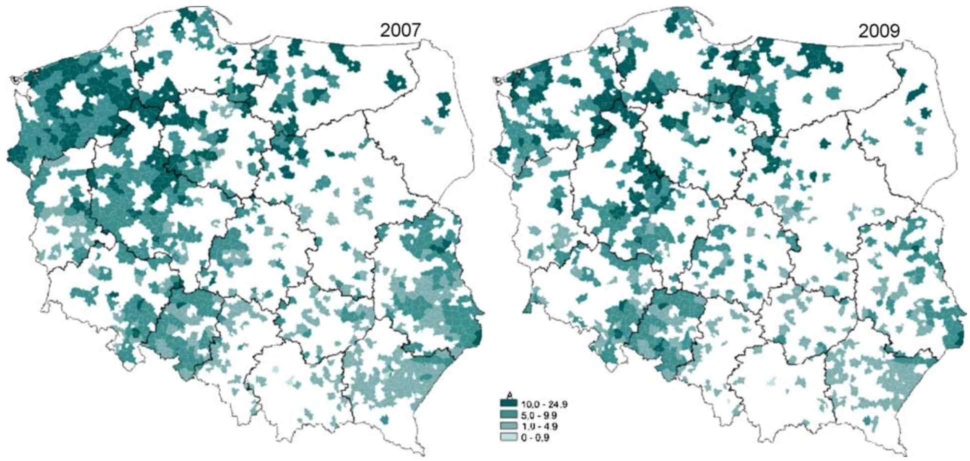


Fig. 6. Average farm area in the gminas where energy crops are grown in Poland in 2007 and 2008. Explanation: A-farms average size (in hectares).
Source: developed by the authors based on the data collected from ARMA and RDB CSO.

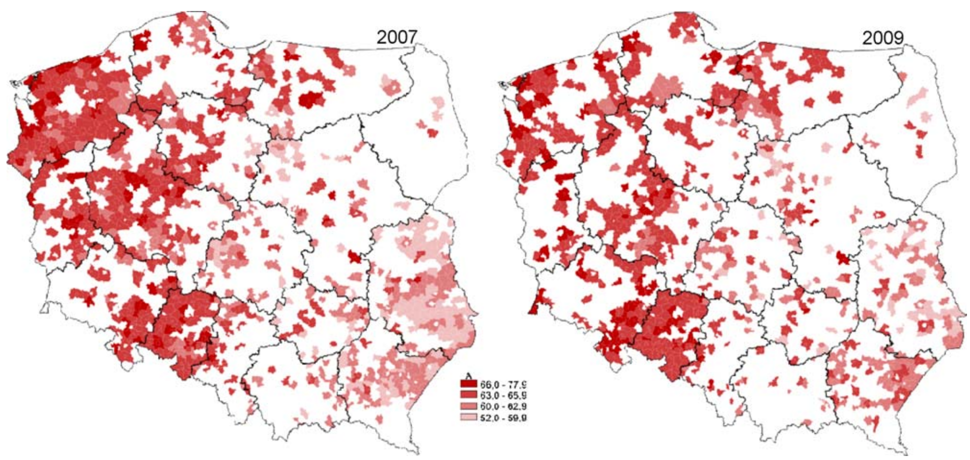


Fig. 7. Shares of working age population in the gminas where energy crops are grown in Poland in 2007 and 2009. Explanation: A-shares of working age population in total population (%).
Source: developed by the authors based on the data collected from ARMA and RDB CSO.

over and the average farm size was in 2007 $r = 0.30$.[3] Moreover, an increase in the share of small farms of 1–5 hectares producing energy crops was recorded. This was mainly due to the fact that energy crops were introduced in central and east Poland (see Fig. 6).

A human factor is yet another crucial endogenous factor which conditions diversification of economic activity. Introduction of innovations, both technological and technical, in rural areas is dependent on the proper level of human capital, including working-age population. Considering the age structure of the population of the analysed gminas, both in 2007 and in 2008, it can be observed that the share of the working-age population in a total number of population is much higher in west and north-west Poland (Fig. 7). If we compare Fig. 7 (share of the working-age population in total population in the gminas where energy crops are cultivated in Poland in 2007 and 2009) with Fig. 3 (energy crops area Poland in 2007 and 2009) it is clear they show similarities. Thus, it can be concluded that there is a certain interdependency between the share of working-age population and the energy crops area in Poland. This interrelation is also reflected by the value of the correlation coefficient, which in 2007 was $r = 0.23$ and in 2009 $r = 0.19$. The areas with a larger share of working-age population (west and north-west Poland) show a larger energy crops area. It seems optimistic, thus, that the share of working-age population is growing.

4. Conclusions

According to the research results it can be concluded that the main exogenous factor which conditions diffusion energy production based on biomass from energy crops is the inflow of capital. In Poland it is the outside source of finance, i.e. the EU funds which initiate diversification of plant production as well as relatively high purchase prices for energy crops.

One of the leading factors which condition the competitive and highly productive agricultural production is the agricultural land quality and farm structure. Due to their lower environmental needs energy crops should gain importance in the areas where agricultural land are less fertile. However, the results of this study also show that this endogenous factor has a limited influence as energy crops are also cultivated in the areas which show higher agricultural land quality and are generally perceived as those where food crops are cultivated (e.g. the regions of Dolnośląskie, Wielkopolska, and south Lubelskie). According to the investigation energy crops, which need extensive cultivation, gain importance in the areas where the average farm size exceeds 10 hectares.

Moreover, it must be emphasized that the most crucial endogenous factor which determines economic activation of rural areas is

[3] All values of the correlation coefficient was calculated at the 0.05 level.

the human capital. The results clearly indicate that a larger energy crops area in west Poland as well as the growing importance in creating the bioenergy centre based on agricultural production are correlated with the larger share of working-age population in this part of the country. This is because young people are more eager to take risks connected with the introduction of innovative solutions. It is also them who are more flexible in adjusting the structure of their agricultural production to the market needs and the possibilities of getting funds from both the state and European sources.

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